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Abstract

Analysis of Human-Spacesuit interaction

Astronauts sustain injuries of various natures such as finger delamination, joint pain, and redness due to their interaction with the space suit. The role of the Anthropometry and Biomechanics Facility is to understand the biomechanics, environmental variables, and ergonomics of the suit. This knowledge is then used to make suggestions for improvement in future iterations of the space suit assembly to prevent injuries while allowing astronauts maneuverability, comfort, and tactility. The projects I was involved in were the Extravehicular Mobility Unit (EMU) space suit stiffness study and the glove feasibility study. The EMU project looked at the forces exerted on the shoulder, arm, and wrist when subjects performed kinematic tasks with and without a pressurized suit. The glove study consisted of testing three conditions – the Series 4000 glove, the Phase VI glove, and the no glove condition. With more than forty channels of sensor data total, it was critical to develop programs that could analyze data with basic descriptive statistics and generate relevant graphs to help understand what happens within the space suit and glove. In my project I created a Graphical User Interface (GUI) in MATLAB that would help me visualize what each sensor was doing within a task. The GUI is capable of displaying overlain plots and can be synchronized with video. This was helpful during the stiffness testing to visualize how the forces on the arm acted while the subject performed tasks such as shoulder adduction/abduction and bicep curls. The main project of focus, however, was the glove comparison study. I wrote MATLAB programs which generated movies of the strain vectors during specific tasks. I also generated graphs that summarized the differences between each glove for the strain, shear and FSR sensors. Preliminary results indicate that the Phase VI glove places less strain and shear on the hand. Future work includes continued data analysis of surveys and sensor data. In the end, the ideal glove is one that provides more tactility for the astronauts but lessens injuries. Often times, a more tactile glove transmits forces better to the hand; thus, achieving a balance of both a tactile and safe glove is the main challenge present.